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Surveys

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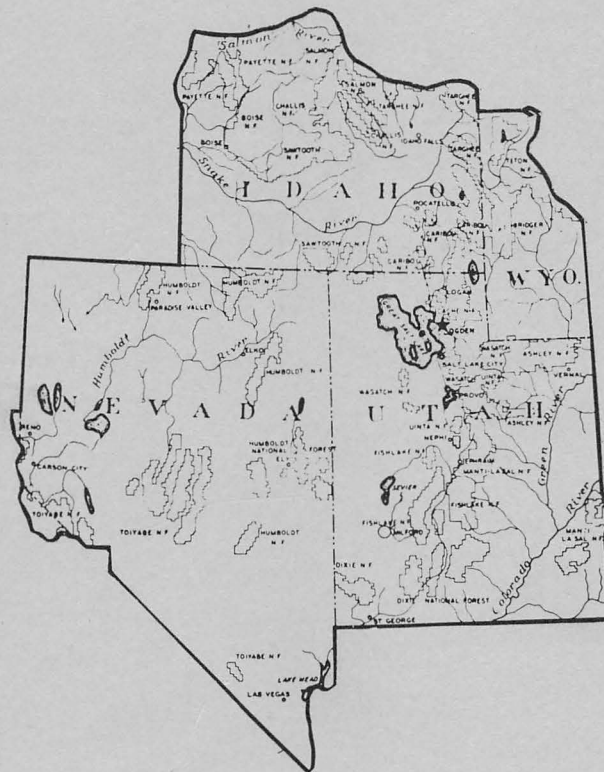
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DEFOLIATOR INFESTATIONS
(OTHER THAN SPRUCE BUDWORM)

FOREST SERVICE REGION 4

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BRANCH OF FOREST INSECT AND DISEASE
PREVENTION AND CONTROL

DIVISION OF TIMBER MANAGEMENT

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INTRODUCTION

A great variety of defoliating insects feed upon the trees and shrubs throughout the area of surveillance of U. S. Forest Service, Region Four. Of primary concern is the destructive capacity of outbreaks in locations where host plants are of importance in area management.

Many defoliating insect outbreaks were evaluated this year. Some infestations are old, having been epidemic fifteen years or more; others are relatively new. A few of the pests are well known. Most are readily recognized but have undergone little study. For some, recorded history is nearly blank. In a few cases taxonomic positions are unknown. Some of the infestations are in important recreation areas; others will affect such miscellaneous products as Christmas trees and wood excelsior. The quality of future timber stands will be affected by some; big game populations by others. A few will kill trees outright, but the majority will cause damage in lesser degrees. Some outbreaks will undoubtedly fade out before significant damage occurs.

Evaluations of these outbreaks included field examinations, collection of biological facts and specimens, and rearing of sample populations to assess the effects of biotic agents. In some cases, specimens were reared through to the adult stage before their identities could be determined. Where outbreaks are caused by little-known pests, evaluations are dependent to a great extent upon the entomologist's judgment, based on interpretations of field observations and analysis of data.

This report is divided into three sections. The first section covers defoliating insects affecting deciduous trees and shrubs. Defoliating insects affecting mountain conifers are covered in the second section, and the last section discusses defoliator outbreaks in the pinyon-juniper type. Maps of several of the larger outbreaks are included. State maps showing relative locations of the various outbreaks are appended.

INSECTS AFFECTING
DECIDUOUS TREES AND SHRUBS

(Insects discussed in this section)

Aspen leaf tier
Fall and spring canker worms
Tent caterpillars
Aspen leaf miner
Sheep moth
Tussock moth
Aphids

Aspen Leaf Tier

A leaf tier, identified as Sciaphila duplex (Wlsh.) is seriously defoliating aspen in many areas in Utah and western Wyoming. Acreages infested by this pest have increased greatly in the past two years. Known infestations occur on the Bridger National Forest in western Wyoming; Dixie, Cache, and Fishlake National Forests in Utah; and the Wasatch National Forest on the Utah-Wyoming border.

Over two hundred thousand acres of aspen are now infested on the Fishlake National Forest. In Sheep Valley, Deer Creek, and Hi Hunt Creek, defoliation ranged from seventy-five to one hundred percent. Several heavily-used campgrounds are within the infestation boundaries. Some tree killing has occurred in areas defoliated two or more years. The Sheep Valley infestation also contains an epidemic population of the large aspen tortrix, Choristoneura conflictana (Wlk). This insect works much the same as the leaf tier. Its presence complicates evaluation of the situation.

Roughly, seventy thousand acres are infested on the Dixie National Forest in southern Utah. Within the Dixie Division major infestations occur southeast of Cedar City, Utah, in the Red Desert area, near Duck Creek Ranger Station; and in nearly all aspen stands from Sugar Loaf Mountain, northeasterly to Bear Valley, a distance of about 20 air miles. The infestation southeast of Cedar City is primarily on private land and forms a triangle running from Lee Point to McFarlane Mountain, thence to just east of Mt. Henry. About 20,000 acres are infested. Defoliation varied from 25 to 100 percent, and egg mass density this fall was very heavy. Another sizeable infestation, about 15,000 acres, is located just east of McFarlane Mountain. This infestation is on both National Forest and private lands in the headwaters of the Deep Creek drainage.

Nearly 15,000 acres are infested in the Red Desert area. The west edge of the infestation is about three air miles east of the Cedar Breaks National Monument. The infestation extends just north of Blue Spring Mountain and southward to the Henrie Knolls. Defoliation ranged from 75 to 100 percent. Egg density was extremely heavy this fall.

Most of the infestations on the Powell Division of the Dixie National Forest occur north of Jones Corral and along the southeast rim of the Aquarius Plateau. The largest infestation extends southward along the main forest road from the Wildcat Ranger Station. In a small isolated infestation on the west rim of the Plateau near Grass Lake, parasites were abundant and caused a marked decrease in population. Fall egg mass density was very light.

On the Wasatch National Forest there are over twenty thousand acres of leaf tier activity. In Horse Creek, south of Robertson, Wyoming, defoliation averaged 35 to 40 percent. Part of the defoliation in Horse Creek was caused by the large aspen tortrix. Along the Provo and Weber Rivers defoliation ranged from 10 to 60 percent.

Approximately eight thousand acres of aspen are infested with the leaf tier in the Upper Green River on the Bridger National Forest. The infestation is across the river and just north of the large Green River Engelmann spruce beetle project. Defoliation ranged from 50 to 100 percent. Only about 1,000 acres were infested last year. Some of the trees in the area which have been defoliated for two consecutive years are now dead, and more are expected to be killed next year.

There are two known infestations of smaller size on the Cache National Forest. These are located in Snow Basin just east of Ogden, Utah, and in Staffer Co-op Basin northwest of Paris, Idaho. In both areas defoliation last summer averaged less than 25 percent.

Premature defoliation of aspen was detected in many other areas throughout the southern portion of the Region, but to date the causal agent has not been determined.

Aspen Leaf Tier Egg Mass Density Per First Six Feet of Bole, Fall 1962.

<u>Area</u>	<u>Ave. number of egg masses per first six feet of bole</u>
Fishlake National Forest	
Sheep Valley	12.1
Puffer Lake	2.0
Dixie National Forest	
Cedar Mountain	4.6
Red Desert	25.0
Bridger National Forest	
Green River	1.6

Various species of Hymenoptera and Diptera parasitized leaf tier larvae and pupae in infested areas. Parasites indentified to date are: Phobocampe sp. and Apanteles sp., Ichneumonidae and Braconidae respectively. Within the areas infested with leaf tier, larval parasitism ranged from 14.2 to 83.3 percent, and parasitism of pupae ranged from .4 to 11.1 percent. Most larval parasites consisted of Hymenoptera species and most affected pupae were parasitized by species of Diptera. Ground inspections of infested areas in August disclosed that leaf tier egg masses were being preyed upon by Formica sp. Within the infestations predation upon eggs by Formicids ranged from 2.0 to 37.7 percent.

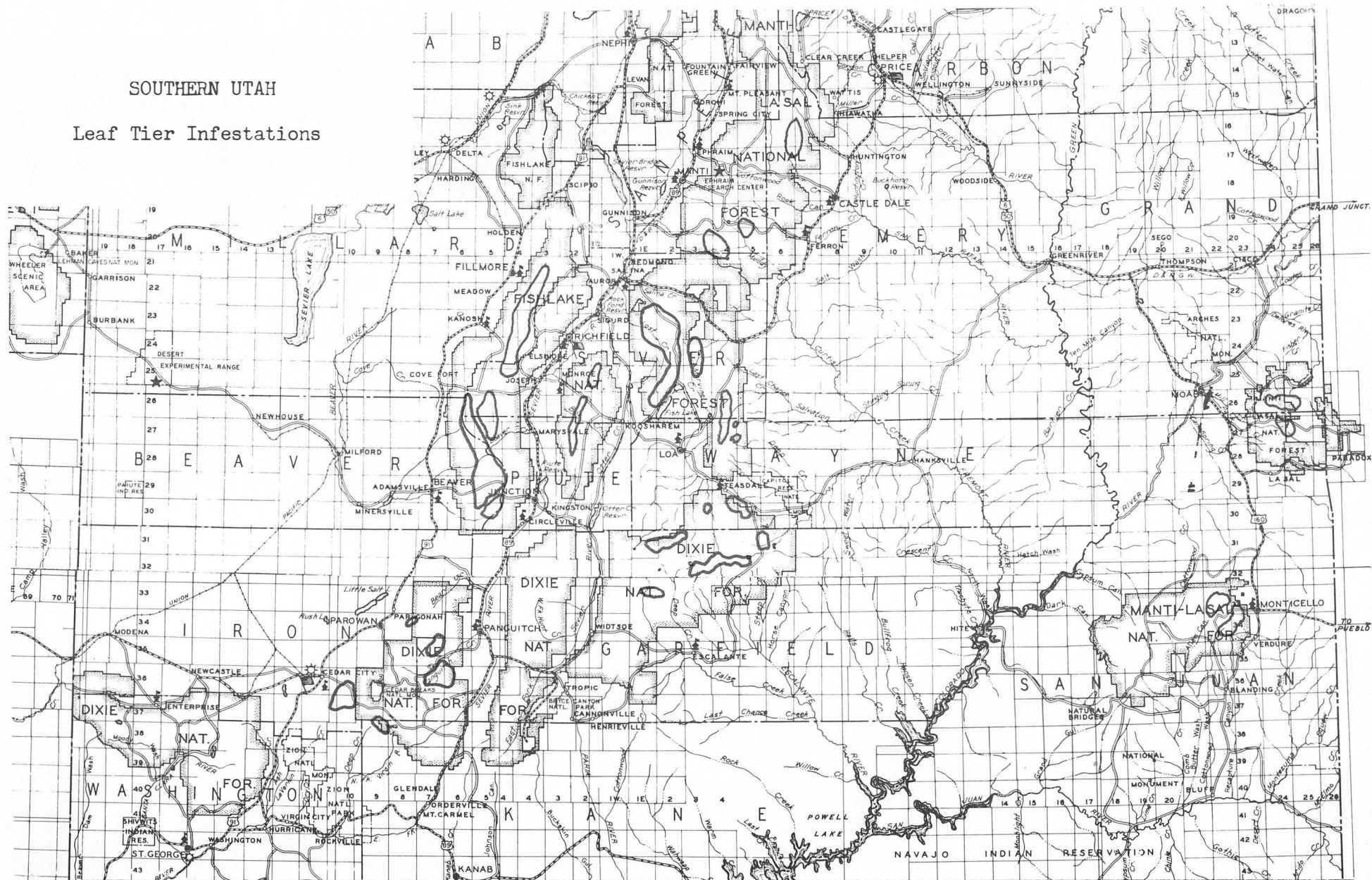
The life cycle and history of the leaf tier was learned during the course of evaluating the leaf tier infestation. This information will be useful in future evaluations.

Evidence indicates two or three successive years of defoliation is sufficient to cause mortality in aspen stands infested by this insect.

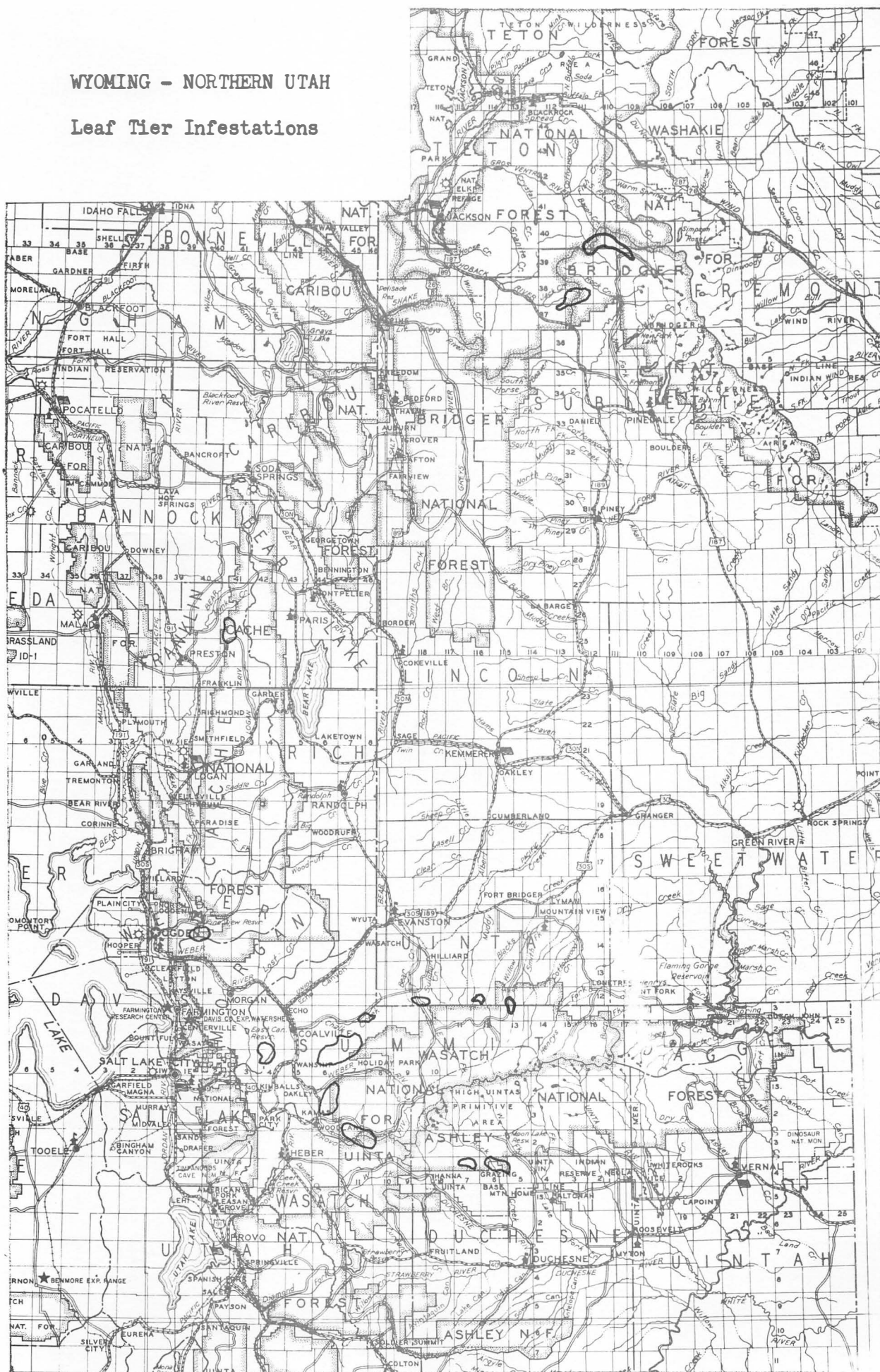
In general, it is expected the leaf tier infestations will increase in size, and defoliation will equal or exceed that experienced this year. Consequently, widespread tree mortality may occur in many of the infested areas.

SOUTHERN UTAH

Leaf Tier Infestations



Leaf Tier Infestations



Fall and Spring Canker Worm

An epidemic outbreak of fall and spring canker worms, Alsophila pometeria (Harris), Paleacrita vernata (Peck), is present in Mill Creek Canyon on the Wasatch National Forest. Mill Creek Canyon is a heavily used recreation area just east of Salt Lake City. This area was partially sprayed last year and again this year. Spraying was by jeep-mounted mist blower. Complete coverage was impossible and box elder, maple, and mountain ash were severely defoliated before the spray was applied. Heavy defoliation was also observed in southeast Salt Lake City immediately adjacent to Mill Creek Canyon. Epidemic populations are expected to be present again next year.

Great Basin Tent Caterpillar

A serious outbreak of the Great Basin Tent Caterpillar, (Malacosoma fragilis Stretch), occurred along the Virgin River and Zion National Park in southern Utah this spring. Aspen, cottonwood, and several brush and browse species were nearly completely defoliated. Evaluations of the infested area showed tent caterpillar eggs hatched approximately two weeks later this spring in Zion National Park than in previous years. Pupation of tent caterpillars this year took place inside the tents. In all previous years pupation occurred outside the tent attached to the bole of trees, or on buildings, rocks or dead logs.

Park Service personnel initiated a partial control program using a bacteria insecticide, Bacillus thuringiensis Berliner. This insecticide proved effective; mortality averaged 80 percent.

The tent caterpillar was also epidemic on approximately 3,000 acres of bitterbrush in Grand Teton National Park and in the Hoback River drainage of the Teton National Forest. The heaviest concentration occurred near the Jackson airport.

The tent caterpillar infestations are expected to be epidemic again next year in both southern Utah and in and around Grand Teton National Park in Wyoming.

Aspen Leaf Miner

The aspen leaf miner, Phyllocnistis populiella Chamb., still persists at epidemic levels on the Targhee, Teton, and Bridger National Forests and Grand Teton National Park. Infestations have existed in these areas for over 15 years. Considerable deformity, with some mortality, is occurring, especially in Grand Teton National Park and Teton National Forest. In many areas, particularly on the Bridger National Forest, aspen leaves were stunted and trees defoliated early as a result of the leaf miner feeding. Increased activity of this pest was also noted on the Cache, Caribou, Uinta, Fishlake, and Dixie National Forests.

The prediction is static to increasing tendencies for all of the infestations. Currently, no effective control measures have been devised for large-scale infestations.

Sheep Moth

Concentrations of a sheep moth larva, Pseudohazis sp., defoliated snowberry and honeysuckle in several localities in northern Utah, southern Idaho, and in Grand Teton National Park. The most noticeable populations in Utah occurred in Snow Basin on the Cache National Forest and along the Alpine Loop Road on the Uinta National Forest. The sheep moth has a two-year life cycle with an overlapping of generations. Some larval parasitism was observed but not sufficient to significantly reduce the population. It appears that defoliation of herbaceous plants within the present infestations will be severe next year.

Tussock Moth

In 1959, an experimental test of virus applied to bitterbrush for control of tussock moth was made south of Reno, Nevada. The virus caused high mortality the year of treatment and apparently remained effective through 1960. However, viable tussock moth egg masses were easily found around the base of bitterbrush within the test area this year. Some plants were heavily defoliated. It appears likely that the tussock moth population will increase again next year. Damage will probably be more severe and it is possible the infestation will spread. Tussock moth egg masses collected near Reno will be force-reared to determine if a virus is present in the population. If the virus is present and next year's larval population is heavy, as predicted, the virus may start exerting a controlling effect.

No tussock moth egg masses were found within the old infestation near Carson City, Nevada.

Aphids

Aphid populations were extremely heavy this year on most deciduous trees. Heavy leaf deterioration, causing noticeable leaf drop, occurred in aspen stands on several National Forests. No serious damage was observed and in all probability these epidemic conditions will be short-lived.

INSECTS AFFECTING
MOUNTAIN CONIFERS

(Insects discussed in this section)

Lodgepole needle miner
Pine needle scale
Pine tube moth
Tussock moths
Pandora moth
Mealybugs
Larch sawfly

Lodgepole Pine Needle Miner

Epidemic populations of Recurvaria milleri Busck., lodgepole pine needle miner, are present in the lodgepole pine stands of the Ashley, Bridger, Caribou and Targhee National Forests.

The infestation on the Ashley National Forest is centered around Greendale Junction, in the new Flaming Gorge recreation area. This infestation has been active for about four years. Of the 40,000 acres infested, less than 9,000 acres are classed as heavily defoliated. Heavily defoliated areas were easily detected this year by aerial observers. Accumulated damage to date has not been severe; but if the infestation continues at its present intensity, the esthetics of this important recreation area could be affected. Winter rearing and evaluations are planned this year in order to determine larval densities and percent parasitism for trend prediction.

On the Targhee National Forest an estimated 100,000 acres of lodgepole pine are presently infested with needle miner. The north boundary of the main infestation starts at Sheridan Reservoir and extends 15 miles eastward to Big Springs, Idaho. From Big Springs the boundary runs southeastward to the southwest corner of Yellowstone National Park. The south boundary extends westward to Big Bend Ridge. The west boundary extends north, from Big Bend Ridge to Sheridan Reservoir. The heaviest defoliation is centered around Island Park Reservoir and Macks Inn, Idaho. This area lies about 14 miles north of an old, heavy, infestation center around Moose Creek Butte and Big Falls on Henrys Fork of the Snake River.

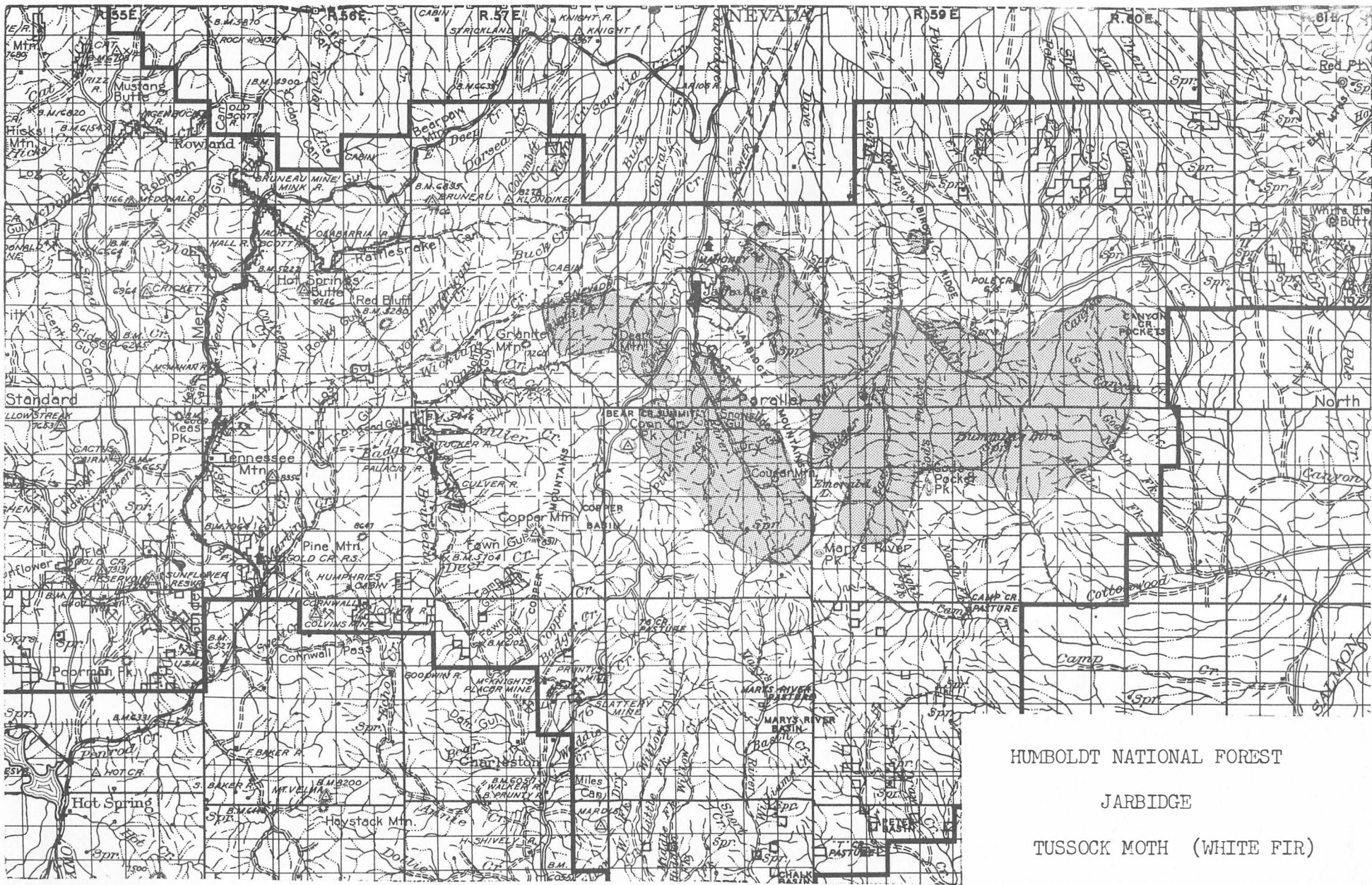
Intensity of defoliation has varied yearly. A heavy flight of adult moths occurred this year, and it is likely the infestation will increase in size and area of heavy defoliation next year.

Two other needle miner infestations in McGarry Canyon and Bear Gulch continue at epidemic levels. In these areas Dioryctria and a budworm, as well as the needle miner, continue to feed on lodgepole pine foliage at about the same level as last year.

Light infestations on the Cassia Division of the Sawtooth National Forest and in Eagle Creek on the Caribou National Forest continue to be static or declining.

Scale Insects in Douglas-fir, True Firs, and Lodgepole Pine

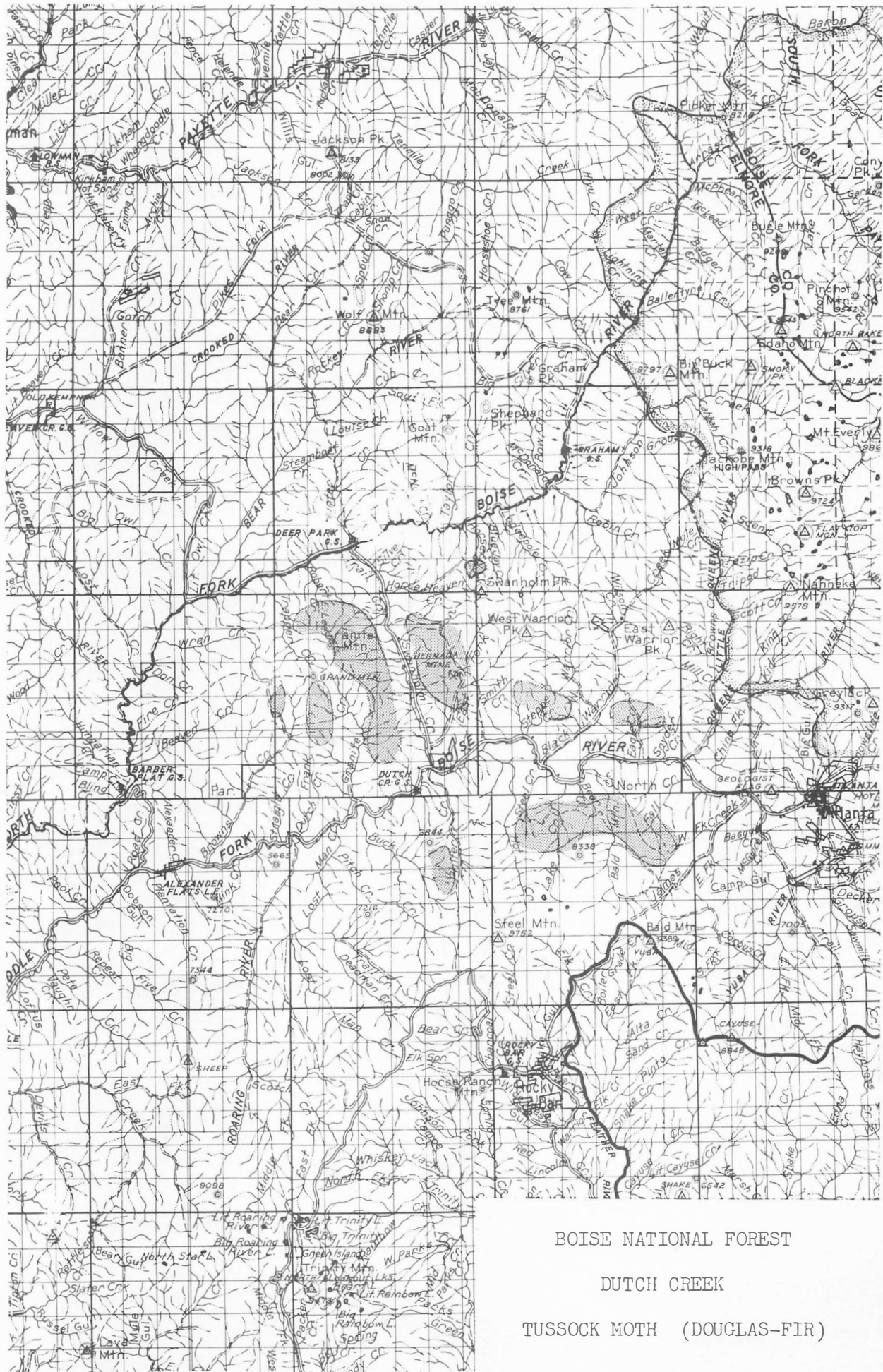
Infestations of the pine needle scale, (Phenacaspis pinifoliae (Fitch)) have increased the past few years in lodgepole pine, Douglas-fir, and true fir stands in many areas. Feeding by scales has caused extensive shedding of needles with defoliation as high as 70 percent in some locations. Overall defoliation averaged only 15 to 20 percent.



HUMBOLDT NATIONAL FOREST

JARBIDGE

TUSOCK MOTH (WHITE FIR)



BOISE NATIONAL FOREST

DUTCH CREEK

TUSsock MoTH (Douglas-fir)

Two predacious coccinellids were observed feeding on the pine needle scale this year. One, Microweisea atronitens (Csy), was collected east of Pioche, Nevada, on white fir infested with scale. This coccinellid was reared in the laboratory and, as larvae and adults, fed on immature stages of scale. This predator may increase to the point where it will be a major factor in reducing the pine needle scale population.

Another coccinellid predator (Exochomus aethiops Bland) was collected on the Sawtooth National Forest west of Ketchum, Idaho. As many as 15 coccinellids per 20-inch sample of infested lodgepole pine branch were counted. Future evaluations are planned to determine if this predator is successful in reducing the scale population along the scenic drive up the Warm Springs River. The same predator was found on the Targhee National Forest, southeast of Pond's Lodge, Idaho, but in fewer numbers.

Pine Tube Moth

A rather serious outbreak of a pine tube moth, tentatively identified as Argyrotaenia pinatubana Kearl., was reported last year. This infestation is in the lodgepole pine stands of the Targhee National Forest. The most serious defoliation is in reproduction and young trees, particularly in cutover areas. Although the infested area increased very little from last year's estimate of 100,000 acres, the main center of the infestation moved westward. In 1961 the heaviest damage was recorded in the vicinity of Squirrel Meadows near the Yellowstone Park, Idaho-Wyoming borders. Heaviest defoliation is now found on the south side of the Island Park Reservoir near Pond's Lodge, Idaho.

No major change in the overall defoliation pattern was noted. Fluctuations in population levels were evident this year; but, in general, the infestation is expected to continue at least through next year at an epidemic level.

Tussock Moth

Douglas-fir stands in the Middle Fork of the Boise River, Swanholm and Dutch Creek areas on the Boise National Forest, are being seriously defoliated by tussock moths. This is a new center of tussock moth activity. Ground evaluations show heavy defoliation on 5,000 acres and medium to light defoliation on 6,000 acres. Heaviest defoliation occurred on 1961 growth. Egg mass counts are high and the infestation is expected to continue at an epidemic level.

A few dead larvae suspected to be virus killed were observed on the foliage of infested trees throughout the area. Egg masses were collected for laboratory rearing to determine parasitism, possibly confirm the presence of native virus, and to measure expected larval density.

White fir stands on the Humboldt Division of the Humboldt National Forest have been defoliated the last two years by tussock moths. At the present time, slightly under 60,000 acres are affected. Out of this gross acreage approximately 21,000 acres lie within the Jarbidge Wild Area. Limited checks made in 1961 showed tussock moth oviposition relatively heavy in

the vicinity of Bear Creek Summit. Tussock moth larvae, subsequently, caused light to heavy defoliation in 1962.

The bulk of the infested area (approximately 47,000 acres) was classified as lightly defoliated. That is, the last two to three inches of the terminals have been stripped of foliage, but feeding was confined to the top half of the tree crown. Moderate defoliation occurred on about 5,000 acres this year. The affected trees have both old and new-growth needles missing in the upper three-quarters of the crown. In some cases as much as three to five feet of the tops of the trees have been completely denuded of foliage. Heavy defoliation of white fir stands (approximately 7,000 acres) occurs in widely scattered locales. The stands in this classification have defoliation occurring throughout the tree crowns, with complete needle stripping in the upper half of the trees. In most of the heavily defoliated areas reproduction suffered the severest defoliation.

No new viable egg masses were found this fall in the heavily defoliated areas around Bear Creek Summit. Further examination showed the possibility of a virus being present in the larval populations. These two factors would indicate that tussock moth populations could possibly have reached a peak of development in 1962 and may fall off rapidly in 1963.

Additional field work and laboratory rearing of egg masses will be necessary to determine if a virus is present and to estimate next year's larval population. When tussock moth larval populations increase to a level where crowding and competition are experienced, native virus often drastically reduces the population. Even if moderate populations exist next summer, the white fir timber will not be damaged to the extent that widespread tree mortality will occur.

Recent developments in the use of polyhedral viruses have demonstrated that these biological organisms can be effectively manipulated to control tussock moth populations in white fir stands. In the event that tussock moth populations continue to build on the Humboldt Division, aerial application of virus could be used to reduce the infestation to tolerable levels.

An epidemic of tussock moth has persisted for several years around Idaho City, Idaho on the Boise National Forest. The preferred host has been *Ceanothus* sp., but other brush species were also fed upon. On two occasions the larvae invaded the Town Creek and Clay Creek Plantations and fed upon the ponderosa pine seedlings.

Laboratory rearings of tussock moth egg masses last winter showed that 3.4 percent of the eggs were parasitized by the chalcid parasite, Ooencyrtus californicus Girault. A native virus caused 73.8 percent mortality to the larvae; consequently, damage was predicted to be rather light. The prediction was confirmed when the tussock moth populations in the summer were greatly reduced by egg parasites and a native virus. Subsequent damage was not severe.

This fall ground evaluations in these areas showed only scattered, small, tussock moth populations to be present. The decreasing trend is expected to continue at least through next year.

Pandora Moth

In 1959 a severe infestation of pandora moth (Coloradia pandora Blake) was detected in lodgepole pine stands near Manila, Utah, on the Ashley National Forest. The infested area increased from 15,000 acres in 1959 to 67,000 acres in 1962. No heavy centers of defoliation developed in areas invaded by the pandora moths in 1960. This was probably because dispersing populations did not concentrate in any one area.

This year several evaluations were made to determine the current status of pandora moth populations. Pupal density samples were taken by spading to a depth of six inches. An average of 1.16 viable pupae per square foot of soil were found shortly before adult emergence. This compared with an average pupal density of 8.7 per square foot found in 1960. These figures indicate that the pandora moth population is continuing its downward trend. Adult populations were considerably fewer in number than in 1960. Also, egg deposition was much lower than that observed in 1960. This confirms the 1961 prediction.

Unless some undetected "hot spots" have developed, the downward trend is expected to continue.

Spruce Mealybug

Spruce mealybug, Puto sp., infestations are still active within Engelmann spruce stands on the Barney and Griffin Top on the Dixie National Forest, and Thousand Lake Mountain on the Fishlake National Forest. Approximately 60,000 acres are infested within these three areas. No appreciable increase in size of infested area and no decrease in severity of damage was observed this year. The mealybugs were first reported on the Fishlake National Forest in 1939 and on the Dixie National Forest in 1955.

The vigorous feeding of the second year mealybugs on Barney Top on the Dixie National Forest resulted in a copious flow of sap from the spruce needles which simplified detection of limb damage. Noticeable limb killing was observed on the Griffin Top this year. Mortality of spruce reproduction is occurring within the older infestations.

Winged males appeared on the Griffin Top this year and will be present in 1963 on the Barney Top. In 1963, mealybugs will give birth to living young, and we expect a considerable population increase on the Griffin Top and on the northern end of Thousand Lake Mountain.

No practical methods are known for controlling or reducing the mealybug populations in these high altitude spruce stands.

The mealybug, Puto cupressi (Coleman), has been epidemic since 1958 on the Payette National Forest. The infestation appears to have a pattern of developing in a drainage, persisting for two to three years, and then nearly disappearing, only to reappear in another location a short distance away. The present infestation covers approximately 500 acres in Big Dave Creek, just north of Hazard Lake. Within the affected area

all alpine fir, and some white bark pine and Engelmann spruce are infested. The mealybugs feed on the older needles and branches, and needles soon become blackened by sooty mold that develops from the honeydew exuded by the mealybug.

To our knowledge no tree mortality has resulted from the mealybug infestation.

Larch Sawfly

An infestation of larch sawfly, Pristiphora erichsonii (Hartig), was discovered in 1961 in Cow Calf, Maverick and Buckhorn Creeks on the Payette National Forest. Fall ground evaluations showed larch sawfly pupal densities indicative of epidemic conditions with an increasing trend. Lab rearing of these pupae revealed a high percentage were parasitized by the chalcids, Euderus sp. and Tritneptis klugii (Ratz). Emergence next spring is, therefore, not expected to be sufficient to produce an epidemic. Here was an example of a fall prediction being reversed by additional evaluations. No noticeable defoliation was detected in the affected areas this year.

This fall aerial observers detected what appears to be a new area of larch sawfly activity south of the confluence of French and Center Creeks, some twenty air miles northwest of the 1961 infestation. Approximately 100 acres of larch is affected. Biological evaluations of the area will be made next summer.

INSECTS AFFECTING
PINYON-JUNIPER TYPE

(Insects discussed in this section)

Scale in Pinyon Pine
Pinyon Pine Sawfly
Cicada

Scale in Pinyon Pine

During the past few years pinyon pine has become increasingly important because of its use for Christmas trees.

Infestations of the pinyon scale, Matsucoccus acalyptus Herbert, have been increasing in extent and intensity throughout pinyon pine type in Nevada and southwestern Utah. Pinyon pine type not presently infested may soon become infested if the present epidemic trend persists. This pest causes shedding of the needles, and in many areas only the new growth remains. Tree mortality has occurred in some locations.

One of the most serious new infestations is southeast of Panguitch, Utah on the road to Panguitch Lake. Approximately 4,000 to 5,000 acres of pinyon are now infested. Defoliation ranges from 30 to 60 percent. Spring evaluations of infested areas showed egg mass densities sufficient to maintain the populations at epidemic levels. Examinations in July revealed scales were present and feeding on fascicles. The number of scales per fascicle averaged from 8 to 15. According to studies undertaken in U. S. Forest Service Region Three, four scales per fascicle constitutes an epidemic population.

It is expected the epidemic will continue in most areas presently infested. It is likely that the infestation near Panguitch, Utah will increase in size. This probably will also be true in most of the newly infested areas in Nevada.

Pinyon Sawfly

At least two, and possibly three, species of sawfly have recently caused defoliation of pinyon pine in western Utah and Nevada. Zadiprion rohweri (Midd), a late summer feeder, caused serious defoliation in several counties of Nevada last year. Neodiprion eduliculus Ross was epidemic in several localities in western Utah and Nevada.

Defoliation of pinyon pine on Pine Nut Ridge southeast of Carson City, Nevada, averaged 70 percent or more last year, but very few larvae were found this year. No larvae or pupae were found in the area infested with sawfly near Pioche, Nevada. Both of these areas are Christmas tree production areas. The cause of the rapid decrease of the sawfly populations is not known; consequently, it is difficult to say whether the population decrease will be temporary or not.

Epidemic populations of these sawflys may exist in pinyon pine stands outside of the areas inspected.

Cicada

Heavy adult cicada populations severely damaged many thousands of pinyon pine trees near Carson City, Nevada. Injuries are caused by the female cicadas depositing their eggs in the twigs. The bark is pushed from the wood and the wood cut and raised so that a series of small bundles of

splinters protrude from the surface. The twigs are often so severely injured by this egg laying that the terminal part of the twig dies.

The damage, while not restricted to Christmas tree production areas, was very severe in the Pine Nut Ridge Bureau of Land Management Christmas tree management area.

Discussion

Intensified use of forested lands in turn requires increased knowledge of forest insect activity. Evaluations of defoliating insects in timber production areas may need to be only of sufficient accuracy to predict if, when, and how much tree mortality will occur. On the other hand, relatively minor defoliation may be of real concern where unspoiled foliage is required such as in Christmas tree production.

The present leaf tier infestations in aspen stands can be used as an example of multiple-use effects of some insect infestations. In Utah, aspen is logged and milled into core stock and excelsior. Tree mortality in commercial stands may materially affect management of these stands. Recreation is affected by loss of trees in important campgrounds where aspen is the principal species. Loss of reproduction affects big game and livestock management.

Egads, FS
to the core
what does
it mean

Strictly from the entomological viewpoint, direct control measures would be justified on many infestations where the trend is increasing. From the land manager's viewpoint, however, values will have to be weighed against control costs and adequate justification is unlikely. Unfortunately, no practical widespread control measures have been developed for some of the defoliating insects discussed in the report.

Additional information on many of the defoliating insects will be acquired this winter through laboratory work. This information will be supplied to land managers upon request.

KEY TO DEFOLIATOR INFESTATIONS

<u>Insect</u>	<u>Host</u>
1. Larch sawfly	Larch
2. Tussock moth	Ceanothus Bitterbrush Douglas-fir White fir
3. California tortoise-shell butterfly and painted lady butterfly	Ceanothus
4. Pine tube moth and pitch nodule moth	Lodgepole pine
5. Lodgepole pine needle miner	Lodgepole pine
6. Aspen leaf miner	Aspen
7. Pandora moth	Lodgepole pine
8. Ponderosa pine needle miner	Ponderosa pine
9. Aspen leaf tier	Aspen
10. Mealybug, <u>Puto</u> sp.	Engelmann spruce
11. Fall and spring canker worm	Box elder, maples and ash
12. Pinyon pine scale	Pinyon
13. Pinyon pine sawfly	Pinyon
14. Mealybug, <u>Puto cupressi</u> (Ehrh.)	Alpine fir and lodgepole pine
15. Great Basin tent caterpillars	Broadleaf, brush and tree
16. Sheep moth	Snowberry

